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THE REPTILES OF GREAT INAGUA ISLAND, BRITISH WEST INDIES

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While on a cruise through the West Indies in the interests of the American Museum and of the Natural History Society of Maryland, the yawl 'Basilisk' was wrecked on Great Inagua Island in the southern Bahamas. Mr. G. C. Klingel remained there from December 10, 1930 to March 11, 1931, and devoted considerable time to collecting and studying the reptiles of the island. Mr. W. W. Coleman, the other member of the expedition, helped greatly with the work but was obliged to return home on January 13, 1931. A brief account of the work, together with some illustration of the lizards and a few of the habitats, has already been published (Klingel, 1932). Although 1734 specimens of reptiles were collected, these include only six species and one subspecies. We believe this small number is a complete representation of all the species of reptiles to be found on the island, exclusive of the sea turtles. No Amphibia were secured in spite of diligent search during both the day and the evening, as well as after rains.

Great Inagua is about forty-five miles in greatest length and eighteen in width. Its reptilian fauna is poorer in species than that of many Bahaman islands of much smaller size, such as New Providence, for example. In attempting to account for the poverty of reptile life on Great Inagua we have examined both the ecological conditions on the island and the relationships of the species found there. Two species and one race are reported below as new. One of these species is so markedly different from *Aristelliger*, to which apparently it is most closely allied, that it is referred to a new genus. The degree of endemism on Great Inagua is exceedingly high.

TOPOGRAPHY AND VEGETATION

Great Inagua is the second largest of the Bahama Islands and the most southern of the series. It is very irregular in outline, but extends in a general east-and-west direction. It is a very flat and low-lying island. The highest elevation according to the West Indies Pilot is East Hill, near South East Point, which rises to one hundred and thirty-

two feet. There are a few hills on the east and south sides of the island and several on the north side, but these are rarely over fifty or sixty feet in height.

From the sea, Great Inagua appears heavily wooded, especially along its north and west shores. On closer inspection the trees and shrubbery are found to be of xerophytic types. The vegetation is largely confined to the coastal stretches of the island but North East Point is wooded across its whole width. Some of the woods, especially those on the north and west sides of the island, are practically impenetrable. Most of the east and south sides of the island are very barren. The plant life is stunted, and the bushes are often not higher than the knee. Sea grapes which reach a height of six or eight feet on the north and west sides of the island usually do not exceed one and one-half feet in height in these areas.

The central part of Great Inagua is occupied by a large lake roughly rectangular in shape and measuring approximately ten by twenty miles. The body of water appears to have no name and is called merely "the lake" by the natives. Apparently no accurate survey of the limits of the lake has been made. It is extremely shallow, averaging only three to four feet in depth. The bottom is largely bare rock with here and there a thin layer of silt. The water is bitter salt and very muddy in appearance. The surface of the lake is dotted with hundreds of islands of varying extent, some very low and others attaining a height of forty feet. Five of the islands on the western edge of the lake were visited but found to be devoid of life. The natives reported lizards present on some of the islands but no attempt was made to check this claim.

The land from the shores of the central lake to within a few miles of the coast forms a great inland plain or savanna (see Klingel, 1932, figure on p. 54). The savanna supports very little vegetation other than a few thin lines of thatch-palm and some buttonwood trees. A few birds and many large land-crabs occur in this area. During the rains large portions of the savanna become covered with water and are impassable. At such times the central lake must increase greatly in diameter. This drowning process may well account for the scarcity of reptile life throughout the central part of the island, but there is still another feature to be considered.

Origin of the Reptilian Fauna

The herpetological fauna of Great Inagua Island is characterized by its high degree of endemism and the small number of species found in this

comparatively large island. Mona Island, only six and one-half miles long by four miles wide, is reported by Schmidt (1926) to support eight species of reptiles and one amphibian. Beata, a small islet of about the same size lying to the southwest of Santo Domingo, agrees with Mona and Great Inagua in its xerophytic vegetation but is now known to include seven species of reptiles within its small confines (Cochran, 1931). On Inagua, regardless of the encroachments of the central lake, there is much more available land than in either of these two small islets, and hence a larger reptile fauna would be expected. The failure of Great Inagua to attain the expected richness of reptile life apparently is due more to the geological history of the island than to the ecological conditions existing there today.

A large part of the island has only recently emerged from the sea. There is much evidence of recent uplift on the island. Perhaps the most conspicuous example is five miles east of Polacca Point. A mile-long section of beach is now two hundred feet back of the shore-line and fourteen feet above the surface of the sea. Near Salt Pond Hill on the south coast is another well defined beach some distance from the present shore.

A comparison may be drawn between Great Inagua Island and the nearby Caicos group. The lowlands of Inagua, like the Caicos bank, face the southwest. There are no hills on the western end of Inagua, and no islands project above the surface of the water on the western end of the Caicos bank. At the present time the Caicos bank appears to be shoaling. We assume that Inagua arose above the sea in much the same way in very recent geological time. The West Indies Pilot (I, p. 184) states:

> There is no doubt that Caicos Bank will, in the course of time, become one island. All evidence points to its constant shoaling. Historical accounts of the pursuits of piratical craft across the bank by naval vessels in the eighteenth and early part of the nineteenth century indicate that even 100 years ago deep channels existed where today a vessel drawing but six feet of water has to proceed with caution. . . .

There are natives on Inagua who recall anchorages once deep which are now shallow. This in itself cannot be considered evidence of uplift. The raised beaches and the general similarity between Inagua and the Caicos Bank, however, are very suggestive of such changes.

Although it is generally agreed that the Bahamas have suffered submergence in Recent geological time, there is evidence that in other parts of the Bahamas this submergence was followed by local movements of emergence. Such recent uplifts have been reported by Vaughan

(1919) in other islands. Although the flooding of the central plain of Great Inagua by rain-water must tend to restrict the ranges of the species, it seems to us that the poverty of species is to be explained primarily by the fact that Great Inagua in Recent geological time was a series of small islands which were incapable of supporting a large reptile fauna. These mother islands which gave rise to Inagua presumably have been isolated from other Bahaman or Great Antillean islands for a considerable period of time, because five of the seven forms of reptiles found on the island are restricted to it. Further, one genus is found only on Great Inagua and Navassa, lying to the southwest. In the following review of the species of reptiles found on Great Inagua we shall emphasize the degree of difference between the species and their nearest relatives, because where a marked difference exists it is usually assumed that a considerable period of time must have elapsed to have produced this divergence.

ARISTELLIGELLA new genus

Closely allied to *Aristelliger* from which it differs chiefly in the increased number of friction pads asymmetrically arranged on one or the other side of the claws. Digits without webs, four outer ones dilated at the extremity and provided with a series of undivided transverse lamellæ below; third and fourth digit of each fore limb and three outer digits of each hind limb with the distal joint long, compressed, clawed, and arising from within the extremity of the digital expansion; first (inner), second and fifth digit of the fore limb, first and second digit of each hind limb short, the claw, except at its tip, concealed by enlarged scales; the inner digit of both fore and hind limb with two enlarged friction disks formed by single scales on either side of the claw, the postaxial one-third larger than the preaxial disk; second digit of both limbs with a similar disk on the postaxial side of the claw; fifth (outer) digit of the fore limb with a similar enlarged scale on the preaxial side of the claw (Figs. 1 and 2). Upper surfaces with granular scales, belly with cycloid scales which tend to imbricate. Pupil vertical, a rudiment of an eyelid above the eye. No femoral, nor preanal pores; hemipenis bifurcate with a calcified tooth-like structure with serrated edges crowning each summit and flanked by a cluster of similar structures of much smaller size.

HABITAT.—Known only from Great Inagua and Navassa Islands, B. W. I.

Aristelligella barbouri,[1] new species

TYPE.—A. M. N. H. No. 45829; adult female; South West Point, Great Inagua Island, B. W. I.; February 1931; G. C. Klingel.

DESCRIPTION OF TYPE.—Snout, one and three-fourths the diameter of the eye; distance between eye and ear opening equal to the distance between eye and nostril; ear opening small, oval and oblique, its greatest diameter a little more than one-third the diameter of the eye. Head and upper surfaces of the body covered with fine granules or at least smooth rounded scales, the scales on the occiput about one-half as

[1]Named in honor of the leading student of West Indian herpetology, Dr. Thomas Barbour of the Museum of Comparative Zoölogy.

large as those between the eyes, scales covering the snout nearly twice as large as those between the eyes, approximately the same size as the scales on the sides of the body; approximately thirty-one scales from the sides of the body contained in distance between tip of snout and middle of eye; a small upright scale over the middle of the eye, smaller than the superciliary scales anterior to it; rostral twice as broad as long with a median cleft above; nostril bordered by the rostral in front by a very narrow scale below and behind and by two supranasals above; ten supralabials, the two posterior ones much smaller than the others, eight infralabials, mental nearly twice as broad as long, sharply pointed behind, the posterior margin bordered by a pair of scales, each scale one-half as large as the first infralabial. Abdominal scales, two to three times as large as dorsals, smooth, cycloid and more or less imbricated. Eight lamellæ under the fourth toe. Tail cylindrical, except near tip where it is slightly compressed; nearly as long as the head and body; tail covered with small, flat, slightly imbricated scales above, with much larger cycloid scales below (regenerated scales short and very wide).

Pale brown above; a broad streak of dark brown on either side of the head merging with a pair of large brown blotches on either side of the neck; this head-stripe margined above with white; the posterior pair of neck-blotches confluent in the midline of the back. A series of six irregular transverse streaks on body, the anterior half of each dark brown, the posterior half white. Tail encircled above with nine broad bands of dark brown, these tending to fuse near the ventral surface of the tail. Ventral surface of head and body white; base of tail pale but remainder ringed with dark brown.

DIMENSIONS

Total length	89	mm.
Snouth to vent	45	mm.
Tip of snout to ear opening	10.5	mm.
Width of head	8	mm.

VARIATION.—The newly hatched young is dark brown with a series of eight saddle-shaped areas of pale gray feebly edged with white extending from occiput to tail (Fig. 3). The ground tone of the tail is a very dark brown and the series of dorsal saddles is continued on the tail as a series of white rings. *Aristelligella* agrees with *Aristelliger* (or at least with *A. lar*) in that the young have much more white on the tail than the adults. With age the pale saddles tend to disappear, while the narrow area between the saddles is retained as a series of dark cross-bands edged posteriorly with white. In adult life there is considerable variation in the intensity of the ground tone, which may vary from gray to brown. The dark cross-bands may become irregular and may be represented merely by transverse spots or streaks of brown or white. The sides of the body also may become flecked or streaked with white. The specimen shown in figure 4 may be considered to have an average development of the color pattern.

RELATIONSHIPS.—Thanks to the kindness of Major Chapman Grant, we have had the opportunity of examining the series of *Aristelliger cochranæ* described by him in 1931. This species agrees with *Aristelligella* and differs from all known forms of *Aristelliger* in the digital characters described above. We therefore refer this species to *Aristelligella*.

A recently hatched individual of *A. cochranæ*, measuring 46 mm. in total length, agrees closely with the young of *A. barbouri*, but the saddles on the back more nearly approach a square. With increasing maturity *A. cochranæ* develops a pair of dark lateral stripes, as already reported by

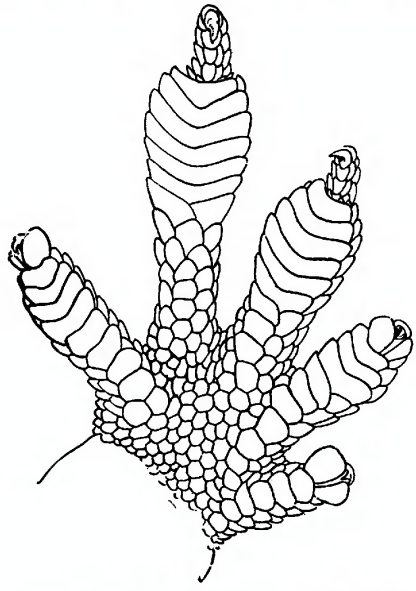

Fig. 1. *Aristelligella barbouri*, new genus and species.
Right fore foot viewed ventrally, ×10.

Major Grant. The adult *A. cochranæ* therefore differs radically from *A. barbouri* in having a pair of longitudinal stripes instead of narrow crossbars. The snout of *A. cochranæ* is narrower and more pointed than that of *A. barbouri*. There are approximately eighteen scales in the loreal region between the nostril and the rudimentary eyelid, while in *A. barbouri* there are fourteen scales in the same distance.

Since the herpetology of Navassa shows close relationships to that of Hispaniola, it might be assumed that *Aristelligella* will some day be discovered on Haiti. *A. barbouri* is sufficiently distinct from *A. cochranæ* for us to assume that there has been little interchange between the faunas of Navassa and Great Inagua for a considerable period of time.

HABITS.—Lizards of this species were found to be very secretive and were never seen abroad during either the day or the night. All of our series of fifty specimens were taken either in decayed wood or under the loose bark of sea-grape or cocoanut-palm. All were collected on South West Point, although a special search was made for them elsewhere on the island, and particularly on North West Point. The majority of the specimens were taken in a grove of dead cocoanut-palms a half mile from the Inagua Light Station.

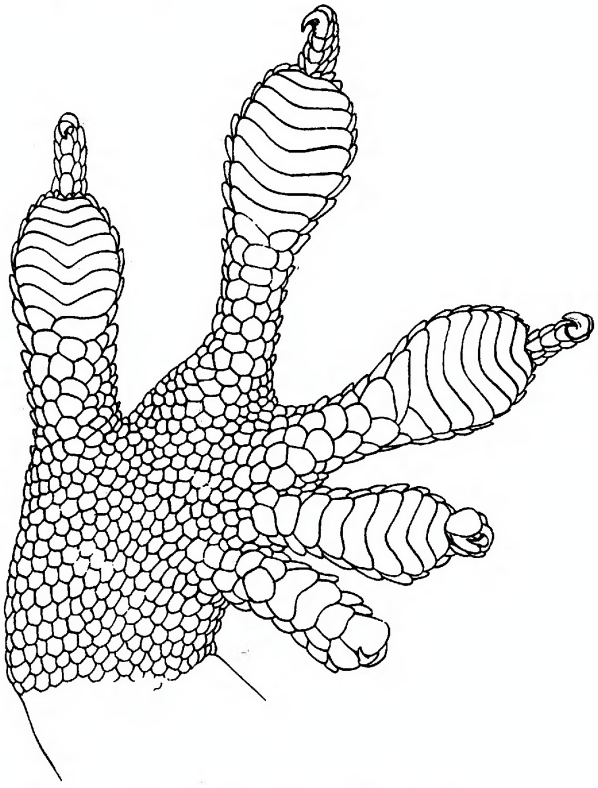

Fig. 2. *Aristelligella barbouri.*
Right hind foot viewed ventrally, ×10.

The discovery of the species came about through the finding of a number of broken egg-shells beside a decayed palm trunk. Search in other dead trees brought to light several clutches of eggs and finally the adults. The eggs with few exceptions were laid in small cavities in decayed wood a short distance under the loose bark. A few clutches were fastened to the bark itself. All the eggs were attached in a more or less

vertical position and were fastened tightly to the wood. There was usually only one egg in a single cavity but in many cases there were several. An exceptional find was a piece of bark approximately 170×100 mm. with twenty empty egg-shells and one good egg attached. It was not unusual to find one or more fertile eggs laid beside broken and apparently long-hatched ones. The eggs were usually attached three or four feet from the ground.

An examination of the oviducts and ovaries of fourteen gravid females showed conclusively that only one egg is laid at a time. In nine of these fourteen females the egg was found in the oviduct, and in four of these cases a calcareous egg-shell had already been deposited. In the five cases where an egg was greatly enlarged but still in the ovary, the remaining ovarian eggs were usually very small. However, in two cases where a calcareous shell had been deposited on the egg in the oviduct, an ovarian egg was found to have enlarged; in one instance to one-half

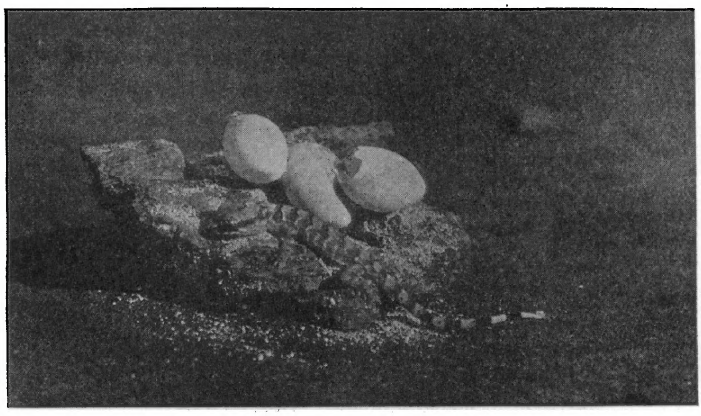

Fig. 3. *Aristelligella barbouri.*
Eggs and recently hatched young. Enlarged about one-fourth.

the diameter of the egg in the oviduct, and in another case to one-third the diameter. We have no data in regard to the frequency at which eggs are laid. Since in our series the females carry only one egg in the oviducts at one time, and since in no case is a second egg ready to be laid, it seems certain that only one egg is laid at one time and that a considerable period must elapse between each egg-laying.

If this be the correct conclusion, the three eggs comprising the group found together and photographed without disturbing them, in all probability, were laid by three different females. It is possible that the

same female laid all three eggs, returning at different times to the same egg-laying site. In either case, the sight of the previously laid eggs appears to stimulate the gravid female, because the eggs are laid in contact even when there is considerable space within the breeding cavity (Fig. 5). While single eggs may be deposited in suitable cavities, our series of eggs reveals a distinct tendency for *Aristelligella* to lay its eggs in contact with those previously laid. From the data at hand it cannot be decided whether the large number of eggs found together in one case

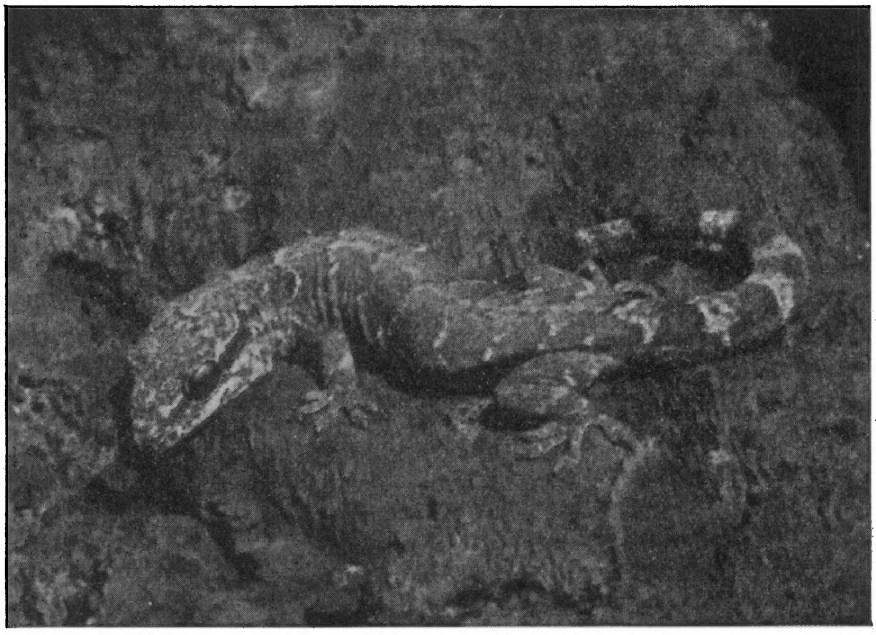

Fig. 4. *Aristelligella barbouri.*
Living adult with average color pattern. Enlarged about two-fifths.

represents a return of a single female over a long period of time to one breeding site, or whether several females were attracted to one favorable spot.

As shown in the photograph (Fig. 5) the eggs of *Aristelligella* are oval and frequently taper more sharply at one end than the other. Four eggs containing living embryos measured as follows: 11.5×8, 12×7.5, 12×8, 12×8.5 mm. in diameter. Two additional eggs preserved in formalin measure 12×8 and 12×7.5. The shell is calcareous, brittle, and as usual in lizards, it is colorless. The living egg is pinkish, apparently due to the underlying vascular membranes.

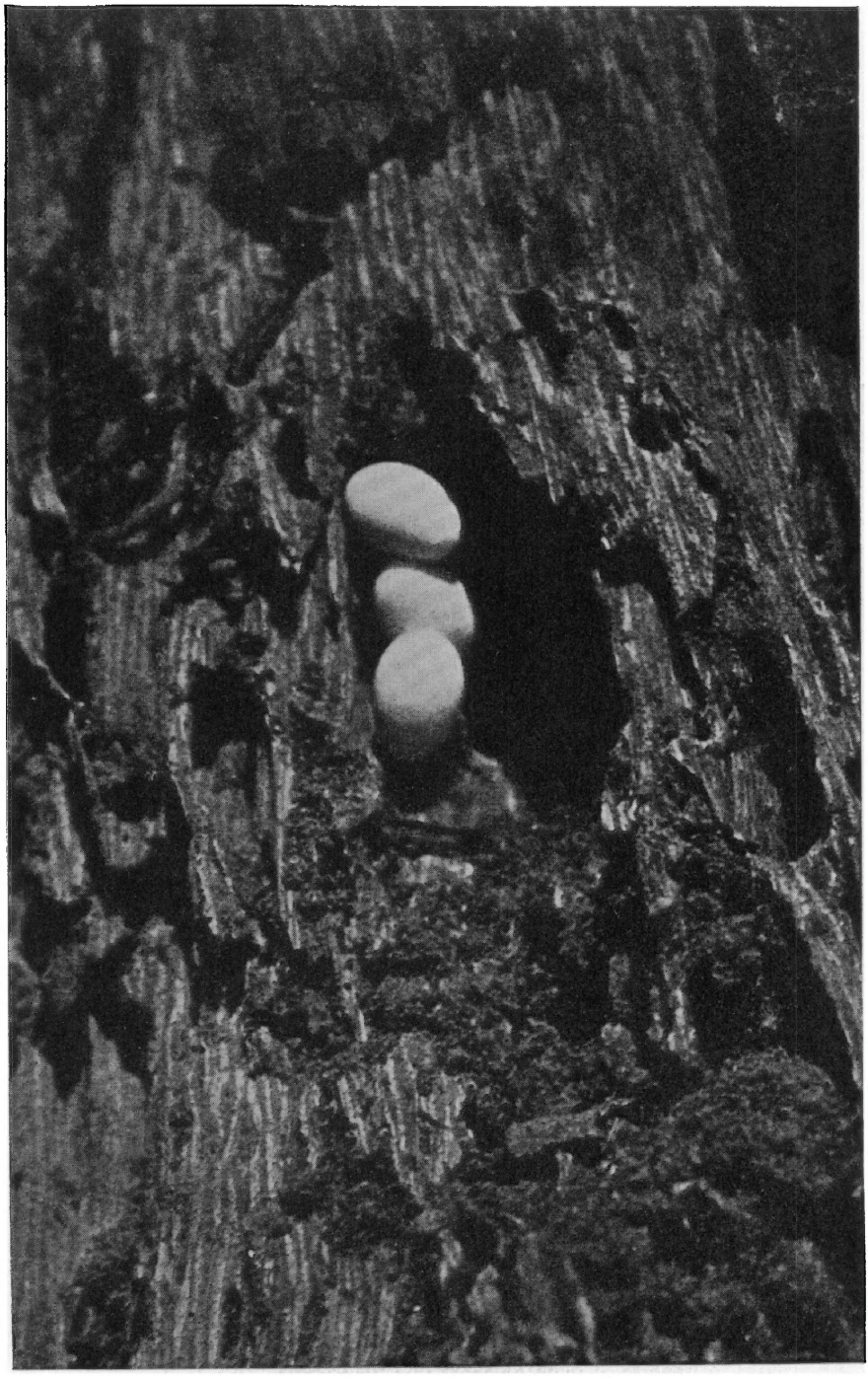

Fig. 5. Eggs of *Aristelligella barbouri* photographed *in situ*.

A female lays only one egg at a time. These apparently were laid by three females in the same hollow. Enlarged about one-third.

The single egg of *Aristelligella* may escape by either the right or the left oviduct. Seven of our nine females containing eggs in the oviducts had an egg in the right oviduct, and only two held the egg in the left. Of the five containing enlarged ovarian eggs, three had hypertrophied, one egg in the right and two in the left ovary. It may be concluded from these data that the right ovary and oviduct functions more frequently than the left.

The first eggs were collected on January 7, the last on February 14, 1931. A female containing an egg in her oviduct nearly ready to lay was preserved April 6. An egg preserved January 20 contained an embryo nearly ready to hatch. Another egg collected February 14 hatched in the laboratory 75 days later. Obviously it had been subjected to temperatures much lower than those of its natural habitat and consequently may have been developing more slowly than it would have if left undisturbed. From these data it is impossible to decide the period of incubation in the species.

In hatching, the young lizards do not cut out of one end of the shell a neat lid as in the case of *Sphærodactylus* when left undisturbed. At least, the one lizard which hatched in the laboratory partly cracked and partly tore its way out. The empty egg-shell remained intact except for the ragged opening through which the young lizard escaped. *Aristelligella* has two forwardly directed "egg-teeth" on the premaxillaries. It is possible that if this egg had been left undisturbed, the hatching lizard would have cut a more regular outlet.

The recently hatched young is dusky brown above with lighter markings. There are seven pale saddles on the back and eight rings on the tail. The proximal saddles are incomplete below and are darker than the distal ones. A dark brown stripe extends along each side of the head and through the eye. The upper surface of the head is paler than the ground tone of the back. The ventral surfaces are pale and translucent without darker markings. The recently hatched lizard measures 38 mm. in total length, 18 mm. in head and body length.

Sphærodactylus inaguæ, new species

DIAGNOSIS.—A small species, adults approximately 50 mm. in total length; scales on snout, except first two or three rows, are feebly keeled, two to three times as large as those on the occiput; scales on the upper surface of the body imbricate and keeled, no mid-dorsal zone of smaller scales; eight scales in a row along the side of the body contained in distance between tip of snout and center of eye; belly scales smooth and rounded, much broader than the dorsals; chest-scales smooth. Sexual dichromatism usually but not always well marked in adults; ground tone a pale brown; males with a series of large dark brown spots on the head, the body with a few small and in-

distinct spots; females with three longitudinal stripes of dark brown on the head and a large dark spot on the scapular region, more or less surrounded by a narrow dark line to form a "target" roughly rectangular in shape; body of female with a few small dark blotches or indistinct cross-bands; tail more heavily spotted but no sacral figure.

DISTRIBUTION.—Great Inagua Island, B. W. I.

TYPE.—A. M. N. H. No. 45746; adult male; Mathew Town, Great Inagua Island, B. W. I.; Gilbert C. Klingel.

DESCRIPTION OF TYPE.—Snout nearly twice as long as the eye (exclusive of marginal fold); distance from tip of snout to center of eye a trifle more than distance from center of eye to ear opening; rostral plate rounded without a lateral ridge or canthus, rostral with a long median cleft behind but without smaller lateral ones; nostril surrounded by the rostral, first labial, the enlarged supranasal and two small scales; a single scale between the supranasals and this scale slightly larger than the small scales covering the upper surface of the snout; three enlarged supralabials; a spine-like scale on the superciliary margin over the center of the eye; scales between the eyes and covering the upper surface of the head posterior to this point small and strongly keeled, only one-half to one-third the diameter of the scales covering the upper surface of the snout; those scales covering the snout are swollen, two or three rows immediately behind the internasals smooth, the remainder feebly keeled; seven scales in a row from the internasals to a line drawn between the corners of the eyes; eighteen scales in a row across the snout from supralabial to supralabial immediately anterior to the orbits; scales covering the upper surfaces of the body strongly keeled and imbricate, eight of those on the side of the body between the two pairs of legs contained in the distance between tip of snout and center of the eye. Longitudinal axis of mental a third longer than same axis of the rostral; three enlarged infralabials, the first twice as long as the second, the second a little less than twice as long as the third; two scales of irregular shape immediately posterior to the mental and only a trifle larger than scales following it; scales of the throat grading off in size posteriorly, those under each angle of the jaw and along each side of the neck are the smallest; those in the center of the throat at a level with the angle of the jaws are slightly smaller than those immediately anterior to them; throat scales posterior to the angle of the jaws increase rapidly in size; scales on chest and abdomen smooth and imbricate, scales on abdomen larger than those on chest and tending to be hexagonal, abdominal scales as long as dorsals and one-fourth broader; a broad band of scales on the preaxial side of forelimbs covered with imbricated scales nearly as large as those on the chest; scales of this series on the upper arm keeled, those on lower arm smooth; the other scales on the forelimbs small and tubercular; scales on the preaxial side of the upper segment of the hind limb similar to the dorsals but smaller, merging gradually into those of the upper surface of the lower leg, which are much smaller and tubercular; scales on the ventral side of the hind limbs like those on the abdomen but diminishing in size distally; scales on the dorsal surface of the tail similar to the dorsal body scales but smaller, ventral tail scales hexagonal and a third broader than long (except the regenerated scales which are much broader).

Ground tone a pale grayish brown. Three longitudinal stripes of dark brown on the snout, the one in the mid-line broader than the lateral ones which cross the loreal region, all three with very irregular margins, upper surfaces of the head posterior to the snout covered with a series of large spots of dark brown, each one-third to one-

half the diameter of the eye; the spots arranged in seven longitudinal rows, but some smaller spots occur ventral to these along the lips and behind the mouth; head spots continuous with a series of smaller spots on the neck, these diminishing rapidly in size until they become the size of one or two scales in the scapular regions; the series continued on the dorsal surface of the body as a series of very indistinct dark spots, most of these covering only part of a scale and many tending to form poorly defined ocelli; the spots increase in size on the tail where they may cover parts of three or four scales; ventral surfaces white, feebly stippled with dark brown along the sides, and spotted with the same tone on each side of the neck and on the under side of the tail.

DIMENSIONS

Total length	50 mm.
Tip of snout to vent	26.5 mm.
Width of head	4.5 mm.
Fore limb from axilla	4.5 mm.
Hind limb from groin	9.5 mm.

VARIATION AND SEXUAL DIFFERENCES.—After an extensive study of the sphærodactyls of Porto Rico and adjacent islands, Grant (1931) has clearly stated the characters which he finds most useful in defining the species of this area. We are indebted to Major Grant for his discovery of a reliable secondary sexual character of value in distinguishing sexes. He states (1931, p. 199): "The male of all species has an escutcheon about five to seven scales long by ten wide, of very smooth, unkeeled scales on the lower belly, not reaching the vent by five or six rows. It extends onto the thighs. It is obvious in even the smooth-bellied species and makes sex determination easy." As shown in Grant's figure (plate xx) this area is often white or poorly pigmented and stands out conspicuously if the belly is colored.

Under the higher binocular powers the scales forming this escutcheon are found to be not smooth, but minutely pitted. Each scale is greatly thickened and its caudal margin does not lie flat like the belly scales but is raised slightly. When the scale is removed and compared with a belly scale the greater thickness of the margin of the escutcheon scale is readily observed. The escutcheon therefore taken as a whole, or as a part, does not present a smooth surface but a decidedly rough front when compared with the broad shingle-like belly scales of *inaguæ*.

The escutcheon from its position may well be compared with the preanal organs of many gekkonids and other lizards. Moreover, it is often continuous with a similar series of scales along the ventral surface of the thighs. In *Sphærodactylus cinereus*, for example, the median shield, or escutcheon proper, is small and a narrow band of thickened scales extends down the ventral surface of the thigh for its entire length.

This band is only three scales wide at the proximal end of the thigh and two scales wide at the distal end. The band is so narrow that it bears an obvious resemblance to a row of femoral organs. In *S. lineolatus* the band of hypertrophied scales on the thighs closely resembles that of *S. cinereus*. In *S. difficilis*, however, the thigh bands have widened and are four scales broad at the proximal ends of the thighs. In *S. goniorhynchus* they are also broad. In *S. molei*, on the other hand, there are no thigh bands. In the adult male a conspicuous shield of swollen scales is found five scales anterior to the vent. The shield is oval in form and does not send two lateral extensions down the thighs. Hence, while the area of hypertrophied scales of *S. inaguæ* and *S. cinereus* can be compared with a confluent series of femoral and preanal organs, that of *S. molei* bears a resemblance to preanal organs alone.

A microscopic examination of the integument from the ventral surface of a male *S. inaguæ* has shown that these hypertrophied scales have a certain structural resemblance to the femoral and preanal organs of other lizards. The epidermis and not the underlying corium of these scales is hypertrophied. While the epidermis covering the scales from the anterior or extreme posterior part of the abdomen averages only three cells in depth, the epidermis of the hypertrophied scales may be formed of eight or more cell layers. In the unmodified scales the two outer layers of cells are flattened, while in the hypertrophied scales all the cells except those in the most superficial layer are enlarged and show no tendency towards a flattening. In fact, many are elongated vertical to the surface of the scale. Where the scale is slightly torn the cells tend to form vertical columns and never the sheets of cells found in unmodified scales. The most superficial layer of the hypertrophied scales is cornified, but since it tends to follow the contour of the underlying cells this layer is very irregular and does not present the smooth surface which characterizes the surface of unmodified scales. In the reduction of the number of flattened cell-layers the hypertrophied scales of *Sphærodactylus* approach femoral organs in structure and differ from the hypertrophied tarsal scale which characterizes the male of certain skinks (Gandolfi, 1908).

Another striking difference between the unmodified and hypertrophied scales was already noted in the external examination. While the normal scales overlap for about one-half their length the hypertrophied scales show very little overlap. The result is that the hypertrophied scales are able to present a firm front to an object rubbed caudo-cephally against them. In this they agree with the femoral organs of male lizard

during the height of the breeding season. They differ from preanal and femoral organs in that the whole scale and not merely a localized portion of each scale is hypertrophied. Since the entire epidermis of each scale is hypertrophied there is no buckling in, or follicle-like ingrowth, of the epidermis such as occurs in the femoral organ. In view of the absence of such ingrowths it might be assumed that *Sphærodactylus* possesses the most primitive type of femoral and preanal organs. Hypertrophied scales may have been the fore-runners of preanal and femoral organs of other lizards but *Sphærodactylus*, itself, is one of the more specialized gekkonids (Noble, 1921) and did not give rise to other less specialized genera possessing the typical femoral and preanal structures.

The hypertrophied scales of the male *Sphærodactylus* doubtlessly fluctuate with the season, for we find considerable variation in the degree of thickening in the large series of specimens preserved in the American Museum. In this seasonal change they further agree with the femoral organs of other lizards.

As a matter of practise we find the hypertrophy of these scales less diagnostic of sex than another male character which we believe has not been hitherto described. The posterior lip of the cloaca is very much broader in the adult male than in the adult female. Most females preserved by ordinary methods in the field have the cloaca closed and exhibit little or no fleshy margin to the caudal side of the cloaca. Most males preserved under similar conditions have this fleshy margin broader and exhibit a tendency for it to fold back towards the tail. The central portion of this lip is usually broader than the lateral portions and hence the lip has a sinuous edge. The only adult males in our series which do not show this distinctive lip are not well preserved or are so bent that the cloacal lips do not meet in the normal way. In checking through the series of sphærodactyls in the American Museum we find the lip less variable than the hypertrophied scales. It is, therefore, probable that it undergoes little seasonal change.

Grant (1931) lays considerable emphasis on sexual dichromatism as a diagnostic species character in his sphaerodactyls from Porto Rico and adjacent areas. Since only *macrolepis* of the species he describes is available to us in series we have made no attempt to confirm his findings. In *inaguæ*, however, we have been able to establish definitely that there is considerable variation in color, and the sexes of adults cannot always be distinguished by a difference in coloration. Fully adult males, as recognized by well-developed femoral and preanal scale hypertrophies, may have a spotted, striped, or rarely a plain head. Adult females containing

well-developed eggs usually have a striped head but the color pattern may be very weakly developed. For example, A. M. N. H. No. 45769 is a breeding male and nevertheless has three longitudinal head stripes and a faint "target" in the scapular region. Again, No. 45783 is an adult female and No. 45774 an adult male and yet both are faintly spotted or blotched over their entire dorsal surface. Since immature specimens have essentially the pattern of the female, it would appear that a small percentage of the males may reach sexual maturity before they have lost the "target" and acquired the head-spotting characteristic of the male. On the other hand, since only a few adult females have a faded pattern, most females are readily recognized by their striped head. In view of the wide limits of variation in *inaguæ*, it seems probable that other species of *Sphærodactylus* are more variable than Grant and others have assumed.

RELATIONSHIPS.—*Inaguæ* is one of the smaller species of *Sphærodactylus*. Like *corticolus* and *difficilis*, adults of *inaguæ* usually exhibit a well-marked sexual dimorphism, the males having round spots on the upper surface of the head, the females elongate spots or streaks. *Inaguæ* differs from *corticolus* in its larger dorsal scales, from *difficilis* in its smaller size and different color pattern. From *monensis* it differs in its smooth chest, "escutcheon" extending down the thighs of the male, and a marked sexual difference in color usually present. From *nicholsi* it may be distinguished by its large size, smaller dorsal scales and the absence of a V-pattern on root of tail. In brief, although *inaguæ* may be closely related to either *corticolus* or *difficilis*, it exhibits several characters which distinguish it from these species and from all other species of *Sphærodactylus* described from nearby islands.

HABITS.—*S. inaguæ* is one of the most abundant species of lizards of Great Inagua. It was found widely distributed throughout all the coastal areas, but was much more common in the north and west than in the south and east. It apparently shows a preference for heavily wooded areas, but was also found in and about houses. Specimens were collected from beneath loose boards and shingles and flat stones. The eggs of *S. inaguæ* were found for the first time on January 20, 1931, on the under side of a tamarind shell. Others were later found in many localities: under flat stones, boards and in hollow sisal stems, under shingles, in roof thatch, and in cocoanut fiber. A photograph of some eggs in the latter situation has already been published (Klingel, 1932, p. 49). Most of the eggs were found in the vicinity of Mathew Town and South West Point. The eggs are laid singly and measure 7×5 mm. when containing well-developed embryos. Only a single egg reaches maturity at one time.

In ten females, taken at random, eight contained a single egg in the right oviduct and two contained an egg in the left. A series of eggs collected February 16, 1931, and maintained at a temperature of 28° C. since February 25, hatched on March 4. Only two other eggs of those collected hatched. One was taken January 27 and the other February 16. Both of these hatched on April 14. Hence the period of incubation lasted at least fifty-seven to seventy-seven days in these two cases. Since no captive *S. inaguæ* laid eggs, the period of incubation is not exactly known.

Recently hatched young are smaller than those of *S. difficilis*. They measure 14 mm. in total length and have a black scapular shield followed by two white spots. There is no white tail-tip as in the young *difficilis*. The iris of both young and old is a pale blue, very different from the dark iris of *difficilis* and other species of *Sphærodactylus* which we have seen alive.

S. inaguæ is essentially a nocturnal lizard, although many come from their retreats at approximately six in the evening. After dark, many are seen running over the floors and walls of the native huts. The local name for *S. inaguæ* is "bubatani," or "snail lizard."

Anolis leucophæus Garman

Anolis leucophæus Garman, 1888, Bull. Essex Inst., XX, p. 109. Barbour, 1930, Bull. Mus. Comp. Zoöl., LXX, p. 129.

The only species of *Anolis* on Inagua varies considerably in color. Specimens fixed in formalin and preserved in alcohol have a ground tone which varies from yellowish white to chocolate-brown. The whole dorsal surface is speckled with small spots of dark brown. In some specimens a series of transverse bars of dark brown extend across the midline of the back. These may be limited to the shoulder region or may form a series extending from fore to hind limb. The speckling of dark brown is also subject to much variation. In a series of specimens from Sheep Cay, near North West Point, the spots may reach a size larger than the ear opening. However, intermediates between this condition and the fine speckling characteristic of most specimens are to be seen in our large series of several hundred specimens from Great Inagua. Further, we can find no structural character to separate these Sheep Cay specimens from the remainder of the series.

In life, *A. leucophæus* exhibits even a greater range of color variation. In the bright light adults are usually a yellowish or grayish white finely speckled with dark gray. In the shade the same specimens may change to a rich brown ground tone above, which makes the dark spotting

inconspicuous. The lips in both pale and dark specimens are often a bright yellow although they vary from this color to white. The throat is often yellow and there may be a suffusion of yellow over the head or, less frequently, on the back. Color change is relatively rapid. Within five minutes a specimen with rich brown tone above and a spotting of a darker brown may fade out to a clay-gray with only the barest indication of the dark spots.

RELATIONSHIPS.—In view of the large number of species of *Anolis* found throughout the Greater Antilles and the Bahamas it is difficult to determine the nearest relatives of *leucophæus*. *Anolis* occurs on many islands, especially in the Lesser Antilles, which apparently were never part of a larger land-mass. It is doubtful, therefore, if the reported occurrence of *leucophæus* on Turks and the Caicos Islands may be considered evidence that these islands were formerly connected with Great Inagua. However, the herpetological fauna of the Caicos Islands is not well known.

Leiocephalus inaguæ Cochran

Leiocephalus inaguæ COCHRAN, 1931, Journ. Wash. Acad. Sci., XXI, p. 39.

Cochran (1931) has briefly described the distinguishing characters of this species which for a long time has been confused with *L. schreibersii*. We have had both species before us alive as well as a series of several hundred preserved specimens and find no tendency toward intergradation. There is only one species of *Leiocephalus* on Inagua and, like many other species of the genus, it exhibits marked sexual differences in color and also a change of color with age. Klingel (1932) has published photographs of both sexes (male figures on pages 44 and 45, female figure on page 46). The immature female is pale grayish brown with a series of twelve or more transverse bars of dark brown down the back. Similar series along each side of the body tend to fuse to form a dark lateral stripe. These bars are continued on the sides of the abdomen as a series of narrow transverse stripes broadly flecked with greenish or white. The under surfaces are white except for these transverse bars on each side of the abdomen and a series of irregular streaks of dark brown on the throat. The streaks in the mid-line of the throat have a longitudinal direction while those on either side extend obliquely from this series. In the adult female the dorsal spots are usually faded and the transverse bars on the sides of the body remain distinct, usually not forming lateral stripes.

In the fully adult male the throat-streaks are black and the transverse bars on the abdomen are suffused with pink. A wash of the same

tone is also found on the under surface of the tail and thighs. Three conspicuous black spots appear on the sides of the body in the shoulder region and these are continued posteriorly along the sides as a series of smaller dark spots. The transverse bars down the back are indistinct and some green occurs in this region.

RELATIONSHIPS.—*Leiocephalus inaguæ* appears to be most closely related to *L. schreibersii*, with which it was previously confused. *L. schreibersii* is abundant in the Monte Cristi region on the north shore of Santo Domingo, only 120 miles from Great Inagua. According to Barbour's most recent list (1930) *L. carinatus* has a wide distribution in Cuba, Isle of Pines, Cayman Brac and Bahamas. *L. inaguæ* is a large heavy-scaled lizard like *L. carinatus* and it is surprising that both *L. inaguæ* and *L. schreibersii* have not been able to extend their ranges to adjacent islands.

HABITS.—*Leiocephalus inaguæ* is found over the entire coastal area of Great Inagua and extends farther inland than any other species. Specimens were collected on the very edge of the barren savannas but no very large individuals were taken in the more arid east and south sides of the island. The species ranges throughout the rocky and more fertile areas and the character of neither the soil nor the vegetation seems to influence its distribution.

Inaguæ was often seen basking in the direct sunlight on the top of rocks, logs, or other points of vantage. Individuals usually appeared between eight and ten in the morning. The more windy or cloudy the day, the later was the first appearance. A record was kept for eight days of the temperature and weather conditions and the time of the first appearance of individuals noted. Temperature appeared to exert less influence than wind. On the clearest and calmest day recorded, the first *inaguæ* were observed at 7:45 A.M. although at that time the thermometer registered 69° F.

Inaguæ, in spite of its comparatively small size, will attack and devour other lizards. Twice individuals were seen to drive full-grown *Ameiva maynardii* from the district under observation. On February 3, 1931, a large *A. maynardii* was shot and fell, twisting and squirming. Before the lizard could be picked up a *Leiocephalus* dashed forward and, seizing the lizard in its mouth, attempted to escape. Large *Leiocephalus* were found to devour *Ameiva* when caged with them in the field.

On the approach of evening the *Leiocephalus* confined in cages would invariably wiggle down out of sight under the gravel covering the floor.

No doubt in nature a large percentage of the *Leiocephalus* make no burrow but merely work their way under the sand or other loose material at night. However, many others were found in holes among rocks, under boards, in hollow decayed palms and even in empty conch shells. Hence the species will seek a wide variety of cover and may not burrow on the approach of night if adequate protection is available.

An experiment was made to determine the range of wandering practiced by the individual lizard. A large number of individuals were captured, were banded with stripes of adhesive tape numbered with black waterproof ink placed around the body just forward of the hind legs, and were released a week and a half later near a stone wall frequented by *Leiocephalus*. The wall afforded many protecting crevices and the exact point of release was carefully noted. The wall was visited for a week and the position of the tagged lizards noted. All lizards released near the wall exhibited a considerable reluctance to seek shelter in its crevices in the manner of the *Leiocephalus* frequenting the region. Of seventy-one tagged lizards released only two were seen the next day on the wall. Another was seen the day after the release on the opposite side of the wall from the place of release. A fourth was seen in a different section of the wall from the place released. When first observed it attempted to escape by dashing into a hole, but finding this too small, it made its way towards another hole. On the third day after the release only a single tagged lizard was seen near the wall although the usual number of untagged *Leiocephalus* were present in its vicinity. This one lizard was seen on the opposite side of the wall from the point of release. No tagged lizard was seen later in the vicinity of the wall. It may be concluded that although lizards released in a foreign territory may tarry a day or more if conditions are suitable, they do not become established there if the region is already inhabited by lizards of the same species.

An attempt was made to discover where the released lizards had gone. One tagged lizard was noted nearly a quarter of a mile away from the wall only two hours after being released. Another was seen two weeks after the release practically the same distance from the wall. Many of the localities from whence the tagged lizards had been taken were visited but none was found to have returned to the home territory. Apparently the lizards after being removed from the original territories scatter widely through the country, radiating from the point of release with great rapidity.

No eggs of *L. inaguæ* were secured in the field although many apparently suitable situations were investigated. On June 17, 1931, a large

female which died in the laboratory was found to contain four large ovarian eggs. Each of the eggs measured approximately 12×12 mm. On August 3 another female laid three eggs in the laboratory. Preserved in formalin they measured 24×11, 22×10, and 19×10 respectively. The eggs are infertile and have become slightly distorted by drying. From this single observation, it would appear that egg-laying of *Leiocephalus* occurs in the autumn.

Ameiva maynardii maynardii Garman

Ameiva maynardii Garman, 1888, Bull. Essex Inst., XX, p. 10.

A. maynardi Barbour and Noble, 1915, Bull. Mus. Comp. Zoöl., LIX, p. 347.

Relationships.—Barbour and Noble (1915) indicated that *maynardii* was closely related to *wetmorei* and *polops* with which it agrees in several structural characters and especially the oblique scales on the dorsal surface of the tail. On the other hand it is obvious that *wetmorei*, *polops* and *lineolata* form a closely allied group from which *maynardii* differs fundamentally in color. Whether or not *maynardii* ever evolved from this group, it is a very distinct form which presumably has been isolated from other *Ameiva* stocks for a long period of time.

Our large series of eighty-one specimens of *A. m. maynardii* from the vicinity of Mathew Town shows considerable variation. The middle of the back is usually a rich blackish brown similar to the sides, but in many specimens the posterior part of this dorsal stripe has faded to a fawn brown or grayish brown. This is an individual and not an age difference, for the extreme fading is reached in both half-grown and adult specimens.

Habits.—In the vicinity of Mathew Town *A. maynardii* is extremely common, especially about the ruins of old houses or partially destroyed walls. This species is uniformly distributed along the north and west coasts of Great Inagua from Mathew Town to Union Creek. Union Creek is a small inlet which extends from the coast to the inland savannas. *A. maynardii* apparently does not occur from Union Creek to Polacca Point, since no specimen was found here although the species was especially sought for over this entire area. This region is extremely rocky with little or no top soil and this may explain the absence of the species throughout the region. *Maynardii*, like other species of the genus, digs numerous burrows in which it spends considerable time. Apparently it is this burrowing habit which restricts the species to areas having a sandy or loamy soil.

On the north coast *maynardii* reappear again in the vicinity of Polacca Point where a number of specimens were found immediately back of the shore-line. Approximately five miles east of Polacca Point the country becomes rocky again and many pitted and greatly eroded stones are found along the coast for about ten miles in a region known locally as the "Ocean Bight." No specimens of *maynardii* were found in this region nor in the sandy country east of it. Apparently this broad belt of rocky coast forms a definite limit to the eastward range of *maynardii* on the north.

In the south, *maynardii* is abundant as far as the drainage canal flowing from the Saltpond, one-half mile south of the Inagua Light Station. This pond is not to be confused with the great Central Lake. It is called "Saltpond" because commercial salt was formerly collected there. Farther south, and to the east along the south coast of Inagua the range of *maynardii* is broken by that of a new form which will be described below.

The burrows of *maynardii* are abundant along the western coast of the island. At Southwest Point many burrows in the sandy soil were excavated and all were found to be very shallow. No eggs of *maynardii* were found here or elsewhere on the island, although a special effort was made to obtain them. Under date of February 14, 1931, Klingel writes in his field book:

"Spent the morning excavating *Ameiva* burrows in the hope of procuring some eggs. Although some twenty burrows were excavated no eggs were found. From three of the burrows adult *Ameiva* were taken. None of the burrows were more than shallow holes in the ground, seldom exceeding a depth of a foot or a foot and one-half. All burrows were in gravelly or sandy soil, principally in sandy. There was no evidence of the elaborate construction such as is found in the burrows of *A. chrysolema*. The total absence of eggs or shells may be considered evidence either that the eggs were laid elsewhere or that the season is not appropriate. However, the presence of young would indicate that hatching must have occurred recently. Apparently we have not yet found the egg-laying site of this species or else the egg-shells have been destroyed soon after hatching."

Although *maynardii* is primarily a ground lizard, on five occasions individuals were seen to climb trees with ease and agility in search of food. In each case the lizards nosed into the corners of branches and leaves searching for insects. Movements of the lizards while in the trees were nervous and quick. One lizard was seen as high as six feet.

Another odd habit was noted in a number of specimens. While walking along the ground the lizards would suddenly stop, the hind legs, body and tail motionless, but continue the walking motion with the front legs. This action would keep up for half a minute at a time. The front legs touched the ground lightly or not at all. Apparently this was a form of exercise for it had no relation to the capturing of food or the digging of a burrow.

Ameiva maynardii uniformis, new subspecies

DIAGNOSIS.—Differs from the typical form only in coloration. Head and body uniform brown or grayish brown above, pale bluish gray or white below. Tail bluish gray, the tip or distal portion of each scale pale blue, the base and usually the greater part of each scale a dark bluish gray. In life, the blue tones are much brighter.

RANGE.—Southeastern half of the island of Great Inagua, B. W. I., as far west as Canfield Bay on the north and South West Point on the south.

TYPE.—A. M. N. H. No. 45404; adult male; Canfield Bay, Great Inagua Island; February 6, 1931; G. C. Klingel.

VARIATION.—*A. m. uniformis* is markedly different from the typical form in color. It was recognized at once in the field as a distinct form and special attention was given to working out its range on the island. Fifty-two specimens were collected, all from eastern and southern part of the island. Not a single specimen was seen north or west of a line drawn between South West Point and Canfield Bay. In this northwestern part of the island 105 specimens of *A. m. maynardii* were collected and many others were seen. In the southwestern part of the island there is some intergrading. Three intermediates were collected on South West Point and four on Salt Pond Hill. At Mathew Town *A. m. maynardii* is the only form present and was found ranging southward to the drainage canal which flows from the "Saltpond" a half mile south of the Inagua Light Station. From South West Point to Conch Shell Point, a distance of eight miles, *A. m. uniformis* is common to the exclusion of the typical form. *A. m. maynardii* appears again on the east side of Conch Shell Point and is common as far as Watering Bluff. From here eastward along the south coast *A. m. uniformis* occurs alone. Intermediates, therefore, were found only where the ranges of the two races meet; they are not uniformly distributed throughout the range of either form. As stated in the introduction the south and east sides of Great Inagua are decidedly more barren than the north and west sides. It is apparent that *uniformis* is a race restricted to the more barren coasts of the island.

In the specimens designated above as intermediate between *uniformis* and the typical form, the lateral stripes have begun to fade

at their extreme posterior end. In these the posterior part of the body is essentially like *A. m. uniformis* while the anterior part retains some evidence of the characteristic dark lateral stripe of *A. m. maynardii*.

If *uniformis* occured within the range of *maynardii* it would doubtlessly be regarded as a mutant not worthy of subspecific designation. It is interesting to note that where the range of *uniformis* overlaps that of the typical form, there is an intergradation of color pattern. It agrees, therefore, with other subspecies in having a distinct range and in intergrading with the typical form where their ranges overlap.

Tropidophus pardalis canus (Cope)

Ungalia cana Cope, 1868, Proc. Acad. Nat. Sci. Phila., p. 129.

Tropidophis pardalis canus Stull, 1928, Occ. Papers Mus. Zoöl. Univ. Mich., No. 195, p. 28.

Ten specimens of the only snake on Great Inagua were collected. They vary considerably in color. Stull (1928, p. 29), the most recent reviser of the group states:

"This subspecies may be distinguished from other forms of *pardalis* by its coloration (white or grayish yellow, as opposed to gray or brown)."

In our series the ground tone varies from a pale gray (A. M. N. H. No. 45838) to a brown (A. M. N. H. No. 45844). The dark spots may be dark brown or black. In several specimens the spotting is very poorly developed. In A. M. N. H. Nos. 45840 and 45844 there are no longitudinal stripes even on the sides of the neck. There is also considerable variation in the degree to which the scales are keeled. Two of the palest specimens have less keeling than the others. Nevertheless intergrades exist between the extremes of color and rugosity showing that *canus* is a much more variable race than hitherto assumed.

Habits.—The species was very common about Mathew Town where it was found principally under flat stones and decayed wood and boards. It emerged from its retreat after rainfall. Specimens were collected at Mathew Town, North West Point and Canfield Bay near North East Point. There was no evidence of the occurrence of this snake on the more barren east and south sides of Great Inagua, although probably it occurs there. Apparently the more heavily wooded areas are preferred.

Natives report the occurrence of this species on Sheep Cay, a small island near North West Point, but two trips failed to disclose any specimens from this locality.

The snake was seen devouring *Anolis* on several occasions and once it was observed eating a full-grown *Ameiva maynardii*. Insects, however,

probably form a large part of its diet. One specimen was taken from a hollow and decayed cocoanut tree. It was coiled in a little cavity about seven feet above ground. Its stomach was found to be full of small beetles and spiders.

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